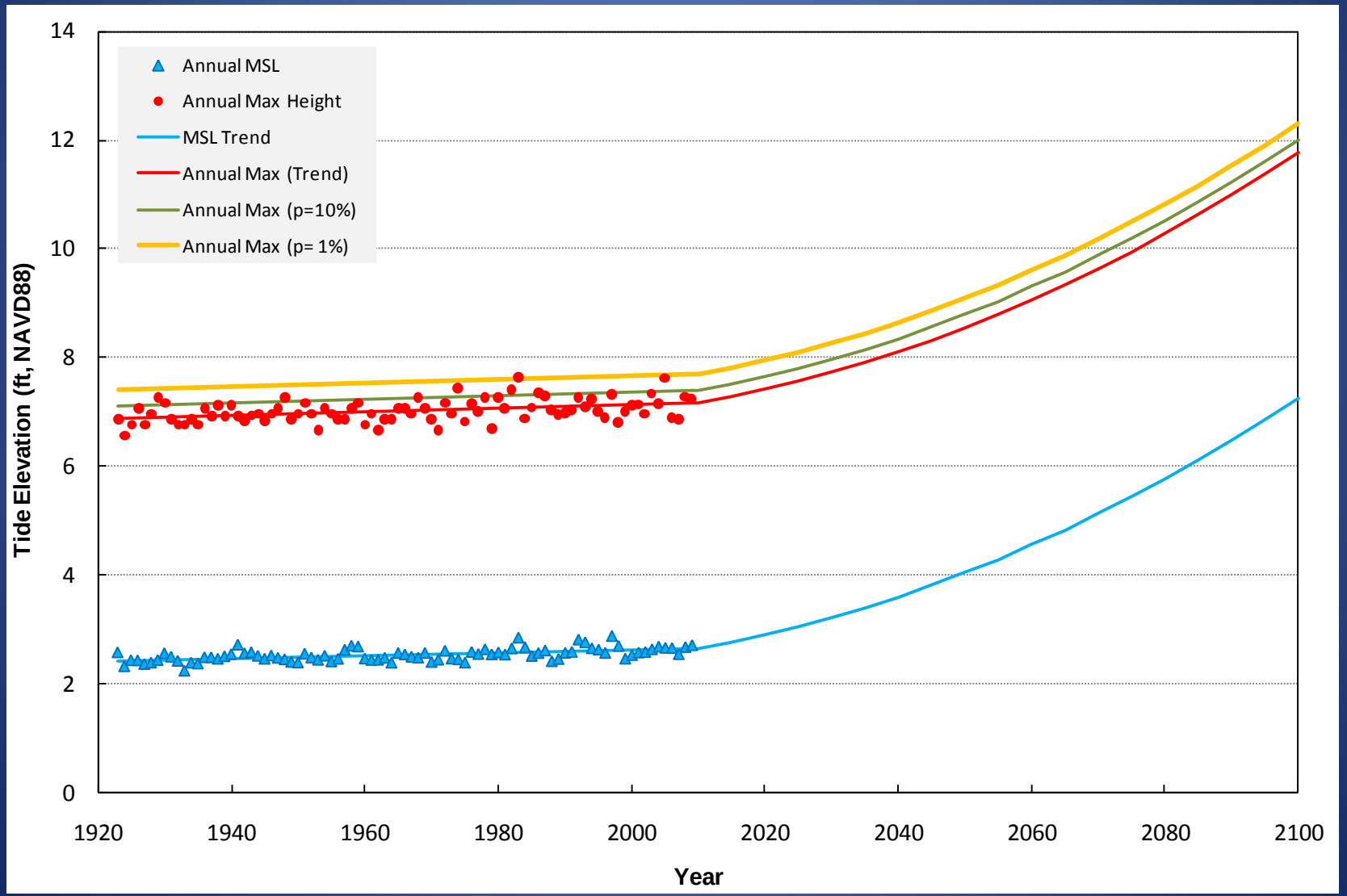
Quick Overview:

IMPACT OF SEA LEVEL RISE ON SEAWALLS AND INFRASTRUCTURE

Tidelands Management Committee
November 16, 2011

Bob Stein, Assistant City Engineer
Public Works Department

Projections of Mean Sea Level and Extreme Tide Heights Through Year 2100



Biggest-ever Jump Seen in Global Warming Gases

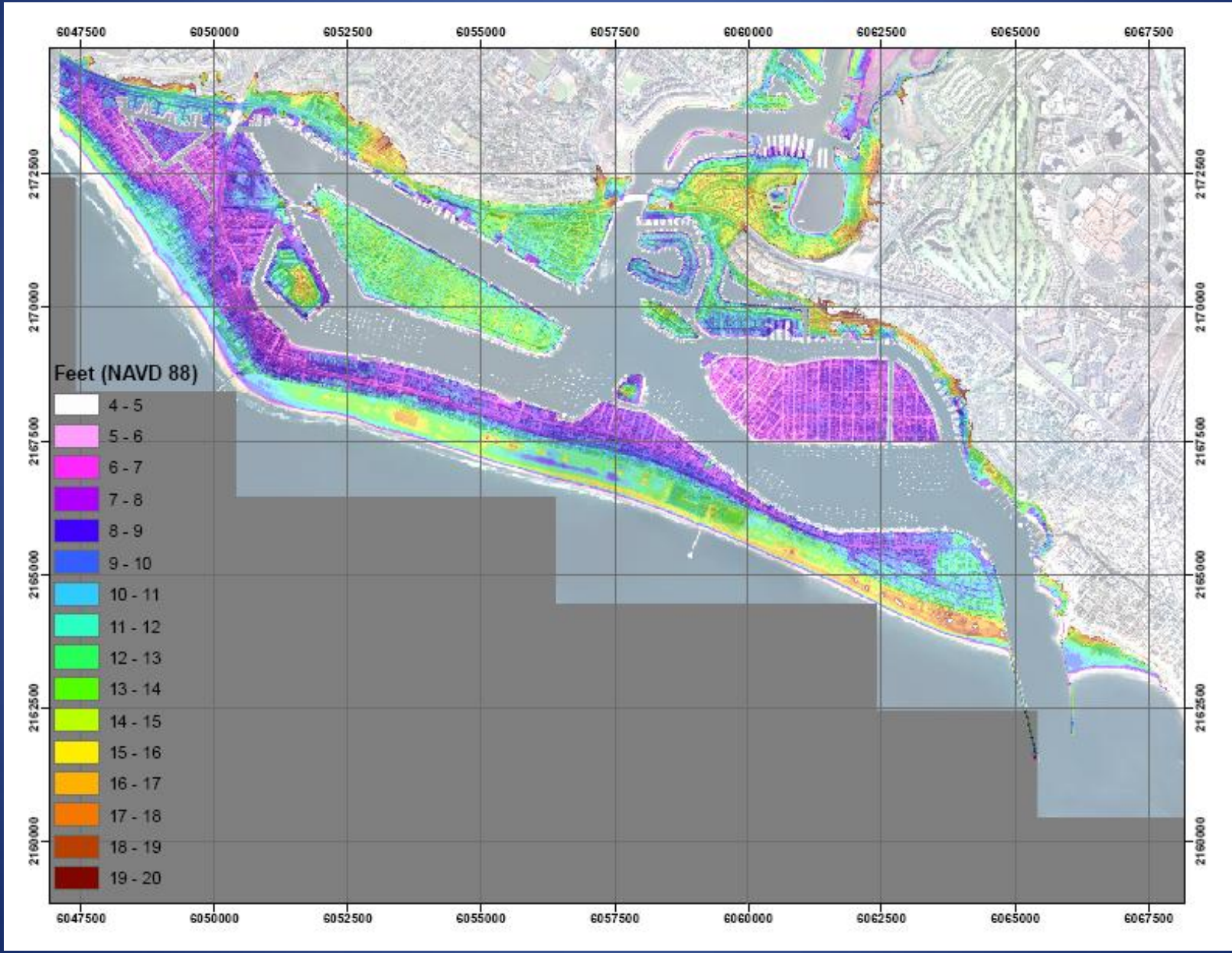
November 4, 2011, 7:19 p.m.

Associated Press

Total emissions jump 6%

between 2009 and 2010 — beyond amounts projected in a worst-case scenario.

Topography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Seawall Construction

2021-2035

a. Construct new seawalls at 10’ MLLW.
b. If needed, construct 6-inch cap on existing seawalls as an interim measure.

2050-2060

Extend new seawalls if necessary to 13 or 14 feet MLLW.

New Seawall Option
Steel Sheet Pile Bulkhead
(No tiebacks)

Public Seawalls

Rough Estimates of Seawall Lengths

- Total Seawall Length – 17-18 miles approx.
- Existing Public Seawalls – 4.5 miles approx.
- Existing Private Seawalls – 13 miles approx.

Back-of-Envelop Costs

- Interim 6” Seawall Extensions
- Construct New Seawalls (10’ MLLW)
- Raise Seawalls to 14’ MLLW

PUBLIC SEAWALLS: $110-120 million approx.

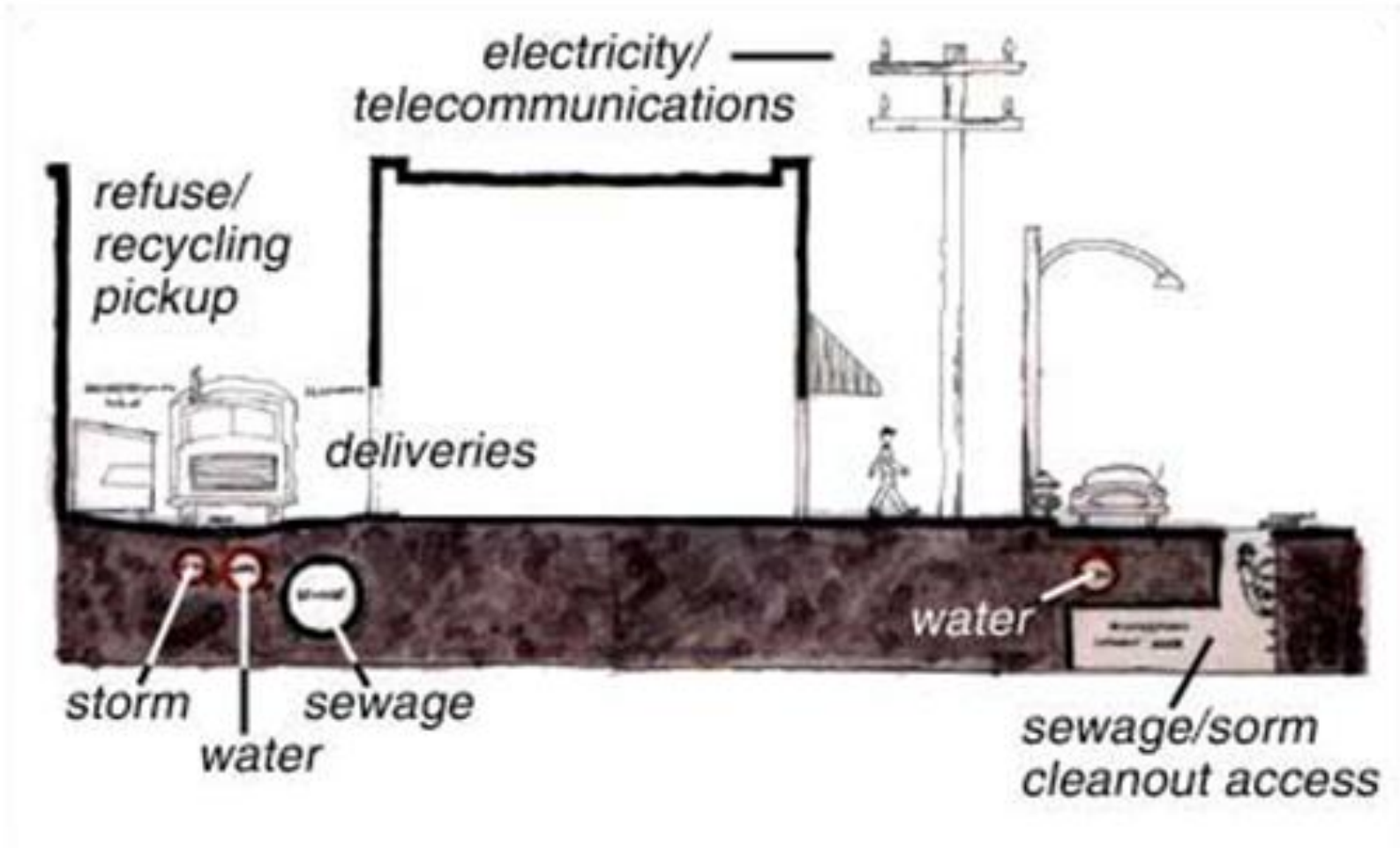
PRIVATE SEAWALLS: $290-350 million approx.

Rising Groundwater

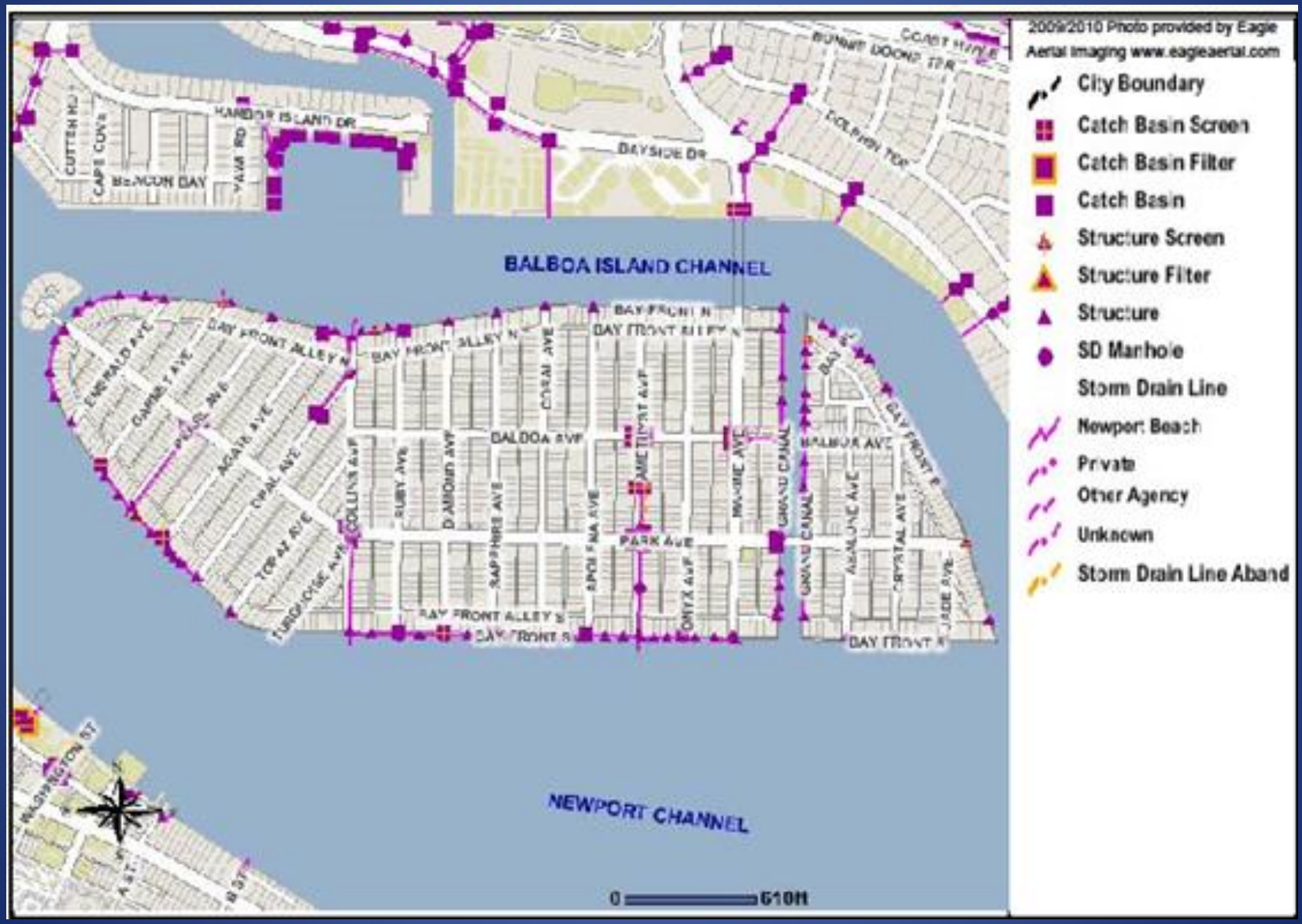
- First Floor Elevations: 6.2 to 11.6 feet (NAVD88)
- 2050 Groundwater elevation at High Water estimated at 6.1 feet
- 2100 Groundwater Elevation at High Water estimated at 9.3 feet

CONSIDERATION: Finish Floor Elevation of 10’ MLLW

Infrastructure



Infrastructure Planning



Storm System Modifications

1. Peripheral drains along boardwalk
2. Storm water capture and pump system

Next Steps

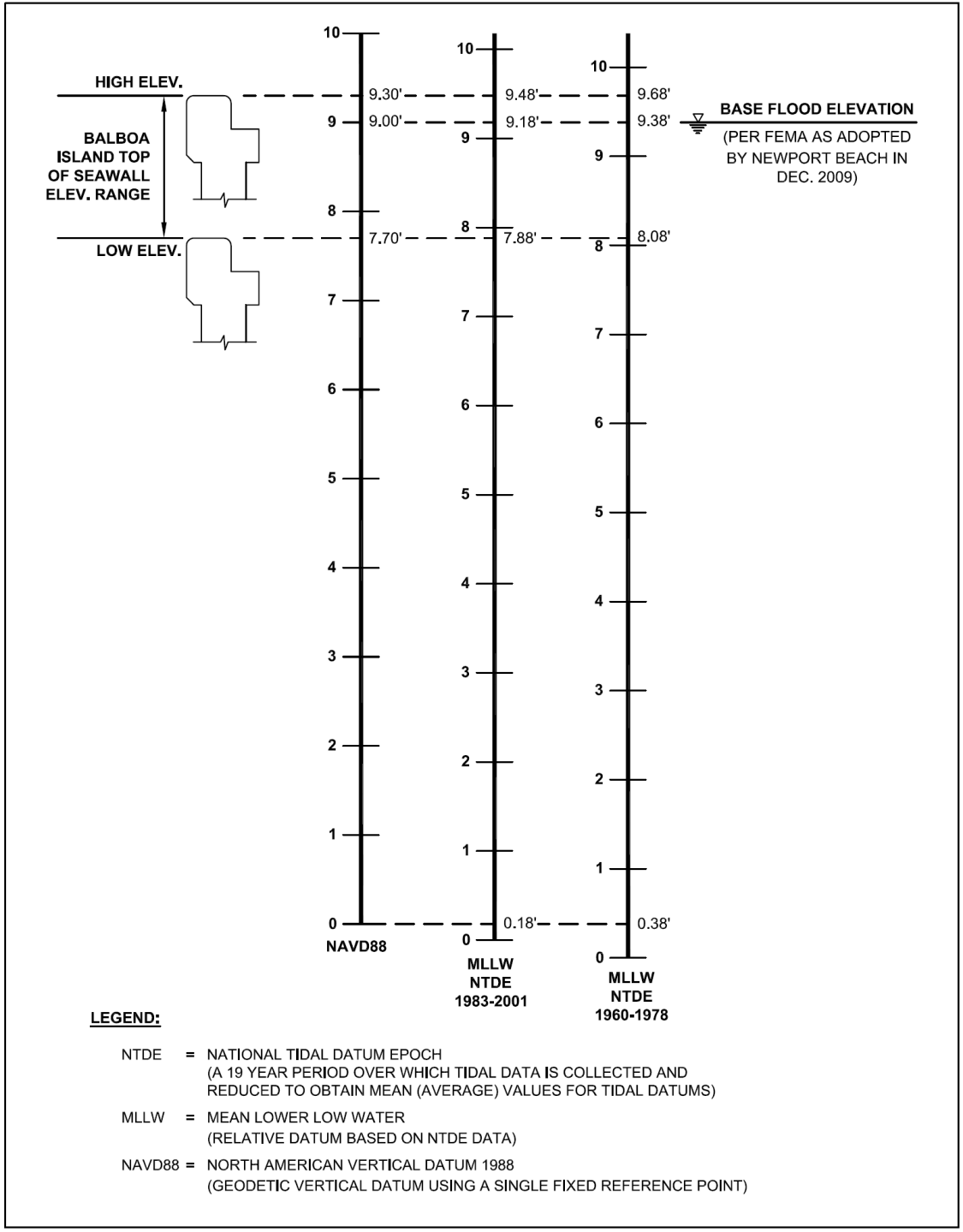
1. Balboa Island concept planning
2. Seawall pre-engineering - Possibility of limited Federal or State Grants
3. Define funding options, e.g. Assessment District Formation

Supplementary slides follow

Seawall Construction Cost Estimates (Concept-Level)

Mitigation Component	Unit Price ($/LF) [1]	Conceptual Cost [2]
Interim Seawall Height Extension		
Alt. 1: New Seawall Cap	$625 - $725	$8.25 - $9.57 million
Alt. 2: Existing Seawall Cap Extension		
Option 1: Mechanical Extension	$250 - $300	$3.30 - $3.63 million
Option 2: Polypropylene Sandbags	$170 - $190	$2.26 - $2.52 million
Option 3: Geotextile Bags/Tubes	$130 - $160	$1.72 - $2.12 million
New Seawall		
Option 1: Steel H-Piles w/ Conc. Panels	$3,800 - $4,000	$50.20 - $52.80 million
Option 2: Steel Sheet Piles	$4,100 - $4,300	$54.10 - $56.80 million
Subsequent Seawall Extension: 3 – 4 feet (When/If Required)	$400 - $500	$5.30 - $6.60 million
Ferry Landing and Bridges		
Ferry Boat Landing and Fuel Dock Retrofit (All 3 Options)		$3.50 -$5.00 million
Bridge Retrofit (3 bridges)	$250,000 - $350,000 per bridge	$0.75 - $1.05 million
Total Estimated Program Cost [3]		**$61.47 - $79.02 million**

Comparison of Different Tidal Datums



Seawall Condition

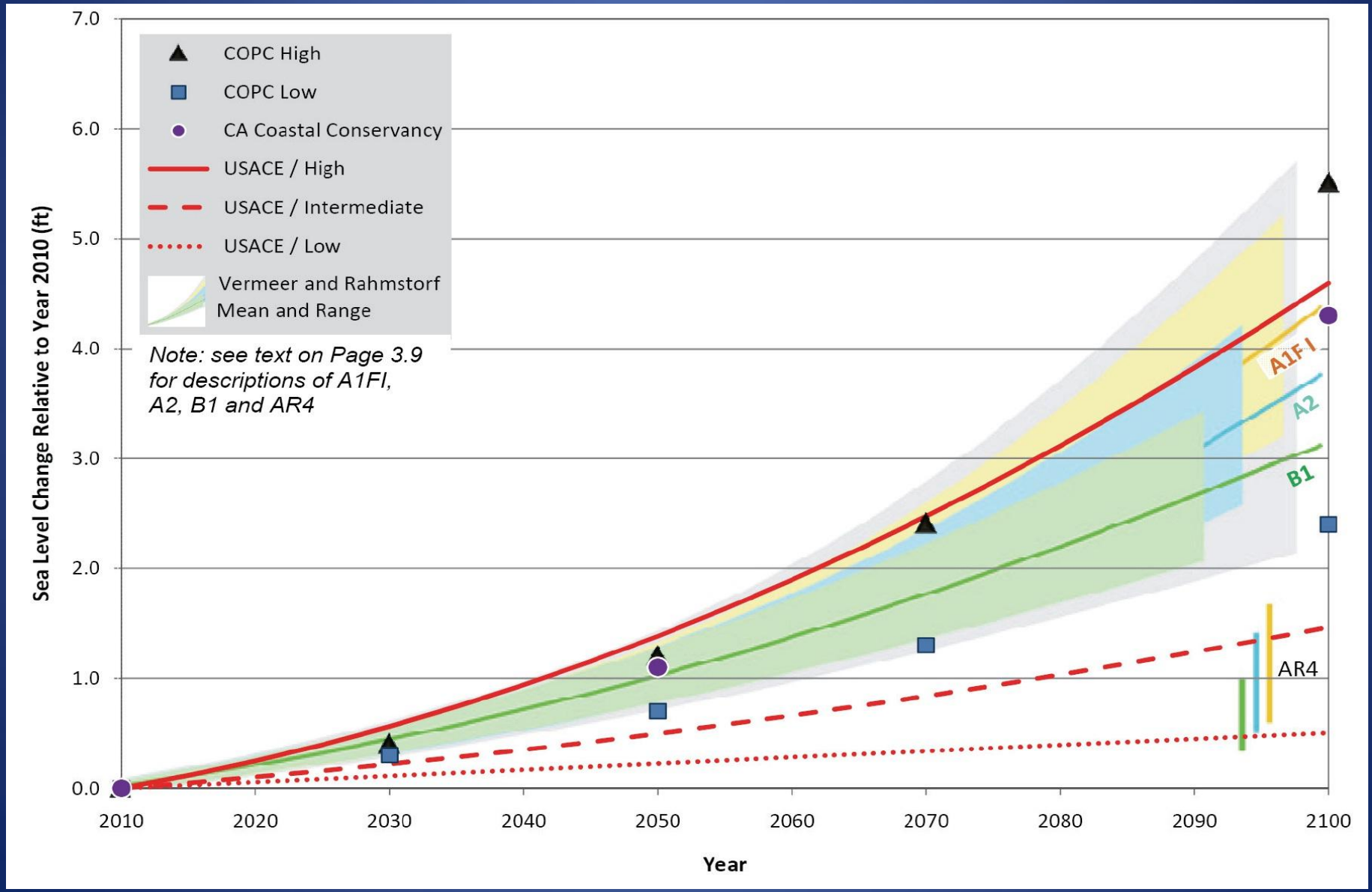
- Seawall Age: 73-82 years
- Overall Condition: Holding together well with widespread cracking and some concrete spalling and evidence of corroding rebar.
- Estimated Useful Life: 10-25 years

Sea Level and Annual Maximum Tide Height Projections Through Year 2100

Year	Mean Sea Level (FT, NAVD88)	10% Tide Height (FT, NAVD88)	1% Tide Height (FT, NAVD88)	Projected Sea Level Rise (FT)*
2010	2.65	7.41	7.71	-
2025	3.05	7.81	8.11	0.40
2050	4.03	8.79	9.09	1.38
2100	7.25	12.01	12.31	4.60

* equals change in mean sea level from Year 2010.

Sea Level Rise Projections



Flood Scenario 6